INVESTIGATION OF REPETITIVE STRAIN INJURY AT BEATRICE FOODS, SIMCOE, ONTARIO

Gary M. Liss, MD, MS, FRCPC
Health and Safety Studies Unit
Ontario Ministry of Labour

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SUMMARY

Following a work refusal at Beatrice Foods, Simcoe, Ontario, the Health and Safety Studies Unit of the Ministry of Labour received a request for assistance in documenting the numbers of cases of repetitive strain injuries (RSIs) and carpal tunnel syndrome (CTS) in this workplace. The plant manufactures ice cream and popsicle products; in the Packaging Department, the site of the work refusal, the workers rotate among jobs of wrapper, packer, and sleever. The seniority lists for 1979 through 1990 indicated that there have been between 48 and 101 employees in the bargaining unit over this time period.

Employees with possible hand, wrist, and forearm problems were identified from WCB Form 7s, from a list prepared by worker representatives at the time of the work refusal, and from company accident reports. Following consent, medical confirmation of diagnoses of RSIs, CTS, and operations for CTS were then obtained from the physicians involved. The relative risk among Beatrice employees was estimated in two ways: (1) The rate of CTS operations between 1979 to 1990 was compared to that in the general population using OHIP data on physicians' billings for these operations; and (2) the frequency of WCB first payment claims for tendonitis (WCB ICD 7271) and CTS (ICD 7275) during 1987 to 1989 at Beatrice was compared to that among the entire labour force of Ontario.

RSIs had been diagnosed in all 17 workers who signed consents; of these, 9 had had operations for CTS, but one had had this operation prior to working at Beatrice. Compared to the remaining 8 cases, an estimated 0.80 CTS operations would be expected among the 150 employees on the seniority lists 1979 to 1990, if the estimated rates in the general population were present at Beatrice. This gives a Standardized Morbidity Ratio of 10.0 (1-sided $p=2.1 \times 10^{-6}$); in other words, the operations occurred 10 times as frequently as expected.

There were 6 WCB first payment claims for tendonitis and CTS among Beatrice employees during 1987 through 1989. This frequency was about 68 times that in the entire Ontario labour force.

This investigation has shown that RSIs, and particularly CTS, documented by medical records, have occurred frequently at this plant. The risk for RSIs at the severe end of the spectrum (CTS operations) is about 10 times that in the general population, and at the mild end of the spectrum (clinically recognized CTS and tendonitis resulting in WCB claims) over 60 times that in the labour force. The former figure represents an underestimate, however; if repeat and bilateral procedures among Beatrice employees were also included, the relative risk for CTS operations would be about twice that calculated. Use of OHIP billing data for CTS operations represents a simple method for estimating the magnitude of the CTS burden of illness at the individual plant level.

Ergonomic changes have been recently introduced at Beatrice. Data on WCB claims and CTS operations should be re-evaluated about 2 years after these changes to assess their effectiveness.

ABBREVIATIONS

CTS	**Carpal tunnel syndrome: manifestations including pain, numbness, tingling, and weakness in the median nerve distribution of the hand as a result of compression or irritation of the median nerve as it passes through the carpal tunnel in the wrist.**
EMG	**Electromyography: a method of recording the electrical currents generated by an active muscle.**
ICD	**International Classification of Disease**
JHSC	**Joint Health and Safety Committee**
NCS	**Nerve Conduction Studies: studies to determine the speed of conduction of stimuli along the nerves.**
NIOSH	**National Institute for Occupational Safety and Health**
p value	**This represents the probability that the data observed could have occurred by chance if the null hypothesis (i.e. no difference between or no effect of exposure groups) is true. A p value of less than 0.05, if the null hypothesis is true, means the probability that the data would show up as they did is less than 1 in 20 (the usual level of "statistical significance"). P values greater than 0.05 mean the probability of the data showing up as they did is greater than 1 in 20 (or compatible with chance).**
PYAR	**Person years at risk**
RSI	**Repetitive strain injury**
SMbR	**Standardized morbidity ratio: a measure of relative risk.** **= ratio of number of observed cases in exposed group (Beatrice employees) to the number expected if the rates (of CTS operations, for example) in the comparison population (the general population, for example) were present in the exposed group.** **If SMbR = 1, then the observed number is the same as that expected;** **If SMbR is greater than 1, then the observed number of cases is greater than that expected;** **If SMbR is less than 1, then the observed number of cases is less than that expected.**
WCB	**Workers' Compensation Board**
W.I.R.S.	**Work Injury Reporting System**

BACKGROUND

In May 1990, following a work refusal at Beatrice Foods, Simcoe, Ontario, the Health and Safety Studies Unit (HSSU) received a request from the Ergonomics Unit for assistance in documenting the numbers of cases of repetitive strain injury (RSI) and an assessment of risk in this workplace.

It has been recognized frequently that workers who perform repetitive tasks are at risk for RSIs such as tendonitis and carpal tunnel syndrome (CTS). Occupations mentioned include garment workers, butchers, grocery checkers, electronics assembly workers, typists, musicians, packers, housekeepers/ cooks, and carpenters (MMWR, 1989; Putz-Anderson, 1988).

The plant and process

The plant manufactures ice cream and popsicle products; in the Packaging Department, the location of the work refusal, there are eight machines, each of which has a number of positions around which workers rotate. The products are cold and the majority of workers do not wear gloves. Details of the actions involved in jobs such as wrapper, packer, and sleever were reviewed in the report by Armstrong (1990). Year-end seniority lists for the years 1979 through 1990 indicated that the number of employees in the bargaining unit had ranged between 48 and 101 over this period; the proportion of females in recent years has been slightly greater than that of males.

Objectives of the Investigation

The objectives of this investigation were to respond to the request for assistance and to 1) identify workers with possible hand, wrist, and forearm problems to estimate the burden of illness; 2) confirm the possible cases using medical records; and 3) determine if there was an association with work by estimating the magnitude of risk in this workplace relative to the general population or the whole workforce of Ontario.

METHODS

A visit was made to the plant in June 1990 with the Ministry of Labour ergonomist for a walk-through survey of the process and to review the records available. A follow-up visit was made

in December 1990 to present preliminary findings to the Joint Health and Safety Committee (JHSC) and to request additional data on termination dates, work histories, and the 1990 seniority list.

1. Identifying those with possible hand, wrist, forearm problems

Several sources of data were available to identify possible cases of RSI including 1) copies of WCB Form 7s (claims initiated) were requested from the company but these were only available from 1987 through 1990; 2) a list prepared by worker representatives at the time of the work refusal containing names of those known or felt to have had RSIs; and 3) "Accident reports" maintained by the company.

2. Medical Confirmation

To obtain medical confirmation of the diagnoses of RSIs, consent forms for release of medical information were distributed to all those on the lists except the following: one who had moved away (current address could not be located), one who was a student and was not in the bargaining unit, and those for whom the health problem on the Form 7 or Accident Report was not related to the forearm, wrist or hands. Separate consent forms were completed for each physician or clinic involved in the case. There was initial compliance with signing consents in all but 2 subjects; these individuals responded with telephone follow-up. Following signing of consent forms, a brief questionnaire was sent to each practitioner asking what hand and wrist problems had been documented with approximate dates of diagnosis; and whether surgery for CTS had been performed, and if so, in what year(s). Only the first CTS operation occurring in 1979 or after was included.

The information was used to categorize the conditions as one of the following:

1) CTS operation; 2) CTS by electrophysiologic findings (EMG/ NCS) but no operation; 3) CTS by clinical diagnosis (possible case) but no or normal nerve conduction studies and no surgery); 4) other wrist/ forearm problems, no surgery; and 5) other condition, with surgery.

3. Estimating risk and association with work

The strength of the association of CTS with work was estimated by comparing (a) the frequency of CTS operations in the Beatrice workforce to that in the general population of Ontario; and (b) the frequency of allowed WCB claims for selected outcomes as coded by the WCB (CTS, ICD code 7275, and tendonitis, ICD code 7271) at Beatrice compared to the general workforce of Ontario.

A. Compared to general population

It was decided to focus on CTS operations, admittedly the "severe" end of the spectrum of RSI, because there is an objective outcome obtainable from medical records. The number of observed CTS operations in the Beatrice workforce between 1979 and 1990 (the years for which seniority lists are available) was compared to the numbers of CTS operations expected in the general population using the ratio known as the Standardized Morbidity Ratio (SMbR) as described in the **Abbreviations** Section above. This expected number is the number of CTS operations expected among Beatrice employees if the general population rates for these operations were present at this plant.

To determine the expected numbers of operations, we assessed the feasibility of using data from hospital discharge and physician billing to the Ontario Health Insurance Plan (OHIP). Initially we intended to use hospital discharges or separations which are coded by the Hospital Medical Records Institute (HMRI). However, it was discovered that the majority of operations for CTS are carried out in out-patient surgery and are not fully captured by HMRI. Consequently, the numbers of billings by surgeons to OHIP for CTS operations (code N290) were obtained from the Ministry of Health.

An explanation of how the expected numbers were calculated is given in the Appendix. An observed CTS operation was excluded if it occurred prior to work at Beatrice or prior to 1979.

The risk is estimated as the SMbR defined as the observed/ expected. Tests of statistical significance were performed assuming a Poisson distribution of observed deaths. Confidence intervals were calculated using a computer program written by Robert Kusiak.

B. Compared to the Workforce of Ontario using WCB data

The observed number of WCB claims at Beatrice (for lost time only) for the company under the ICD rubrics tendonitis (WCB ICD code 7271) and carpal tunnel syndrome (ICD code 7275) were obtained for the years 1987-1989 from the W.I.R.S. (Work Injury Retrieval System). The number of employees on the year-end seniority lists for 1987-89 was considered the population at risk.

For a comparison with the entire labour force, the numbers of lost time claims available from WCB statistics for 1987 to 1989 in the entire workforce for the same two ICD codes were obtained. These claims data are available only by sex, not by age. For the denominator, numbers in the Labour Force of Ontario for the mid-year (1988) were obtained from the Ministry of Treasury and Economics, Sectoral and Regional Policy Branch (Statistics Canada, special tabulation). Because the claims are available only by sex, the results are presented as a crude relative risk as well as with an indirect adjustment for the gender proportions of the Beatrice workforce.

RESULTS

Findings from medical records

A total of 17 workers signed consents. For each, there was a 100% response to the questionnaire from at least one or more physicians (or EMG clinics). Among these 17 "cases", 15 were female, and initial diagnosis occurred between 1975 and 1990. The diagnoses are listed in Table 1. The most frequent diagnosis was CTS operation which is not surprising since the "severe" end of the spectrum of RSIs is being captured by the medical records; of these, one occurred prior to work at Beatrice and is not included in subsequent analyses. Of the 9 cases, three had had operations on more than 1 occasion. A tenth employee is known to have had a CTS operation but was not on the lists. This operation occurred prior to 1979 and is also not included in estimates of relative risk below. These RSIs occurred a mean ($\pm$ standard deviation) of 7.6 ($\pm$5.2) years (range 2.3 to 23.5 years) after starting at Beatrice, at mean age 33.6 ($\pm$7.6); the CTS operations occurred 8.5 ($\pm$ 6.5) years (range 2.2 to 21.2) after starting at Beatrice, at age 36.0 ($\pm$9.4).

Association of CTS operations with work

A. Compared to general population of Ontario

There were 150 employees on the seniority lists between 1979 and 1990, after exclusion of one employee who had a CTS operation prior to working at Beatrice.

The numbers of physician billings to OHIP for CTS operations increased over time (Figure 1). The age-specific proportions for CTS operations (as a proportion of the year's total) for the 3 years for which data were available from the Ministry of Health are plotted, separately for each sex, in Figure 2. Analysis of variance performed separately for males and females showed that the age-, sex-specific proportions were similar across these years; the calculations (see Appendix) assume similar proportions over all years 1979-1990. The age-specific proportions and estimated rates were greatest in females 45-59 years (Figures 2 and 3).

The observed and expected CTS operations by sex and time period are given in Table 2. Less than one operation was expected among the 150 Beatrice employees in the seniority lists between 1979 and 1990. The Standardized Morbidity Ratio for CTS operations among Beatrice workers compared to the general population was 11.5 for females (one sided $p=2.7 \times 10^{-5}$; 95 percent confidence interval 3.9, 23.3); 8.69 for males ($p=0.0227$); and overall, 10.0 ($p=2.1 \times 10^{-6}$; 95 percent confidence interval 4.3, 19.7). In other words, the operations occurred about 10 times as frequently among Beatrice employees as in the general population.

B. Compared to the Workforce of Ontario using WCB data

Numbers of claims for Beatrice

There were six WCB claims for tendonitis and CTS at Beatrice Foods for 1987 to 1989 (Table 3A).

In comparison, in the labour force in Ontario during this 3-year period, the total number of claims for tendonitis and CTS in the entire labour force and numbers in the labour force for

1988 by sex are shown in Table 3B.

The crude RR for tendonitis and CTS claims at Beatrice relative to the general working population is 69.7, or almost 70 times as frequent. Indirect adjustment (standardization) based on sex-specific rates in the workforce resulted in an adjusted RR of 67.5 ($p=6.35 \times 10^{-10}$; 95 percent confidence interval 24.7, 150).

DISCUSSION

This investigation has shown that CTS made up the majority of the RSIs among workers at Beatrice Foods documented by medical records, and that the rate of operations for CTS (the severe end of the spectrum) at this plant was about 10 times greater than that expected in the general population, based on a new method utilizing OHIP billings data. At the milder end of the spectrum, first payment compensation lost time claims for tendonitis and CTS were an estimated 68 times that in the labour force as a whole.

This is consistent with other studies that have included food and assembly line tasks among those at high risk for CTS and other RSIs (MMWR, 1989; Putz-Anderson, 1988). It would be of interest to determine if other producers of dairy products/ ice cream in Ontario have had similar experience with RSIs.

The data sources available were limited in a number of ways, which may underestimate the burden of illness recognized. First, there may have been incomplete identification of subjects having had CTS operations; the sources may be biased towards inclusion of more recent occurrences and against inclusion of more remote events. For example, Form 7s were only available from 1987 onwards. Second, there have been changes in the recognition of the work-relatedness of RSIs over time. Both the WCB claims and work-refusal list capture only the more severe end of the spectrum, i.e. those seeking medical attention, compensation, or known by those making the list to have had problems. If a survey or physical examination were also conducted, more RSIs (both CTS and non-CTS) would likely have been elicited; if access to OHIP data on individuals were permitted, additional cases of CTS at this plant may have been identified but this is currently not possible due to confidentiality limitations.

Moreover, the data for one other individual at Beatrice who had a CTS operation prior to 1979 are not included because seniority lists are not available for that period.

Fourth, the OHIP billings data represent procedures, not individuals. Thus, individuals with operations on greater than one occasion would be counted more than once. As noted above, in the calculations used, each worker was counted only once. Of the individuals with CTS operations included, one had two subsequent operations and another had one subsequent operation. In addition, at least 9 procedures are indicated from the medical records to have been bilateral. Such interactions with the health care system would result in the N290 codes being billed to OHIP two times (John Gerritsen, Ministry of Health. Personal Communication, April 1991). Thus, the number of operations would likely have been about double that counted, giving a RR estimate closer to 20.

Finally, the WCB first payment data used may also underestimate the burden of illness because claims for RSIs that did not involve lost time are not included. Of course, this applies to both Beatrice workers and the general labour force.

Because age-specific rates for WCB claims in the reference group are not known, the comparisons based on the WCB data could be confounded by age resulting in estimates that are too high (or too low) depending on the differences in age distribution. However, the age distribution of person-years among Beatrice workers during 1984-90 and the labour force in 1988 appear similar (for example, the proportions aged 20-24, 25-44, and 45+, among females were 16.4%, 55.9%, 27.7% at Beatrice, and 14.2%, 58.8%, 26.9% in the workforce, respectively; chi-square = 0.23, 2 degrees of freedom, p=0.89).

This investigation has also shown that provincial health insurance data represent a simple method for estimating, in the future, the magnitude of the CTS burden of illness at the level of the specific plant, that is, as a surveillance tool. If individuals having had such operations can be identified, the relative risk can be determined using the estimated population rates as shown here. This method for documenting CTS operations has the advantage of using an end point that can be objectively confirmed from medical records.

RECOMMENDATIONS

1. These findings should be presented to the Joint Health and Safety Committee.

2. Follow-up data on WCB claims (and possibly on CTS operations) should be obtained some time (e.g. 2 years) following the institution of the ergonomic changes now underway at the plant. The JHSC or union could have a role in collecting this information.

3. Consideration should be given to examining the morbidity experience of other companies in this food sector.

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TABLE 1

DIAGNOSES OBTAINED FROM MEDICAL RECORDS
Beatrice Foods, Simcoe, Ontario

Category	Number of Cases
CTS operation[1]	9[2]
CTS by electrophysiologic studies	1
CTS by clinical diagnosis	4
Other wrist/ forearm conditions	2
Operation for other condition	1

[1] CTS = Carpal Tunnel Syndrome

[2] In one case of these cases, operation preceded work at Beatrice and is excluded from further analyses; 3 had operations on more than 1 occasion. An additional case occurred among a current supervisor prior to 1979 and is also not included in analyses.

TABLE 2

OBSERVED AND EXPECTED NUMBERS OF CARPAL TUNNEL SYNDROME OPERATIONS BY SEX AND TIME PERIOD
Beatrice Foods, Simcoe, Ontario, 1979-1990

	TIME PERIOD						
	1979-1983		1984-1990		ALL		SMbR
	OBS	EXP	OBS	EXP	OBS	EXP	(OBS/EXP)
SEX							
F	2	0.14	4	0.43	6	0.56	10.7
M	0	0.06	2	0.18	2	0.23	8.7
ALL	2	0.19	6	0.60	8	0.80	10.0

OBS = Observed number of operations
EXP = Expected number of operations
SMbR = Standardized morbidity ratio (for explanation, see ABBREVIATIONS Section in text)

TABLE 3

FIRST PAYMENT CLAIMS FOR TENDONITIS AND CARPAL TUNNEL SYNDROME

A. AT BEATRICE FOODS, SIMCOE, ONTARIO 1987-1989

ICD	Year			
	1987	1988	1989	Total
7271	1	0	2	3
7275	2	0	1	3
Totals	3	0	3	6
Numbers on seniority lists	77	77	90	244
(Number males)	(39)	(37)	(42)	

B. IN LABOUR FORCE OF ONTARIO, 1987-1989

ICD	Sex	Year			
		1987	1988	1989	Total
7271	M	503	453	483	1439
	F	607	616	736	1959
					3398
7275	M	270	289	332	891
	F	344	328	458	1130
					2021
			Grand Total		5419
			Yearly average		1806.3

Labour Force in Ontario 1988 (thousands)
Males: 2815; Females 2303

APPENDIX

The expected numbers of operations was calculated using the following equation:

Expected = PYARs x (Age-sex-calendar time-specific CTS rates)

= PYARs x (Age-sex-specific CTS proportion x Calendar time-specific total CTS operations)/age-sex-calendar time-specific population.

where PYARs = person years at risk

To determine person-years at risk (PYARs), the computer program of Coleman et al (1986) was used. For all employees appearing on seniority lists 1979 through 1990 (i.e. those available), the accumulation of observed CTS operations and of PYAR began on the starting date or on January 1, 1979 whichever came later. Observation ceased on the termination date, age 65, or on December 31, 1990 whichever came earliest.

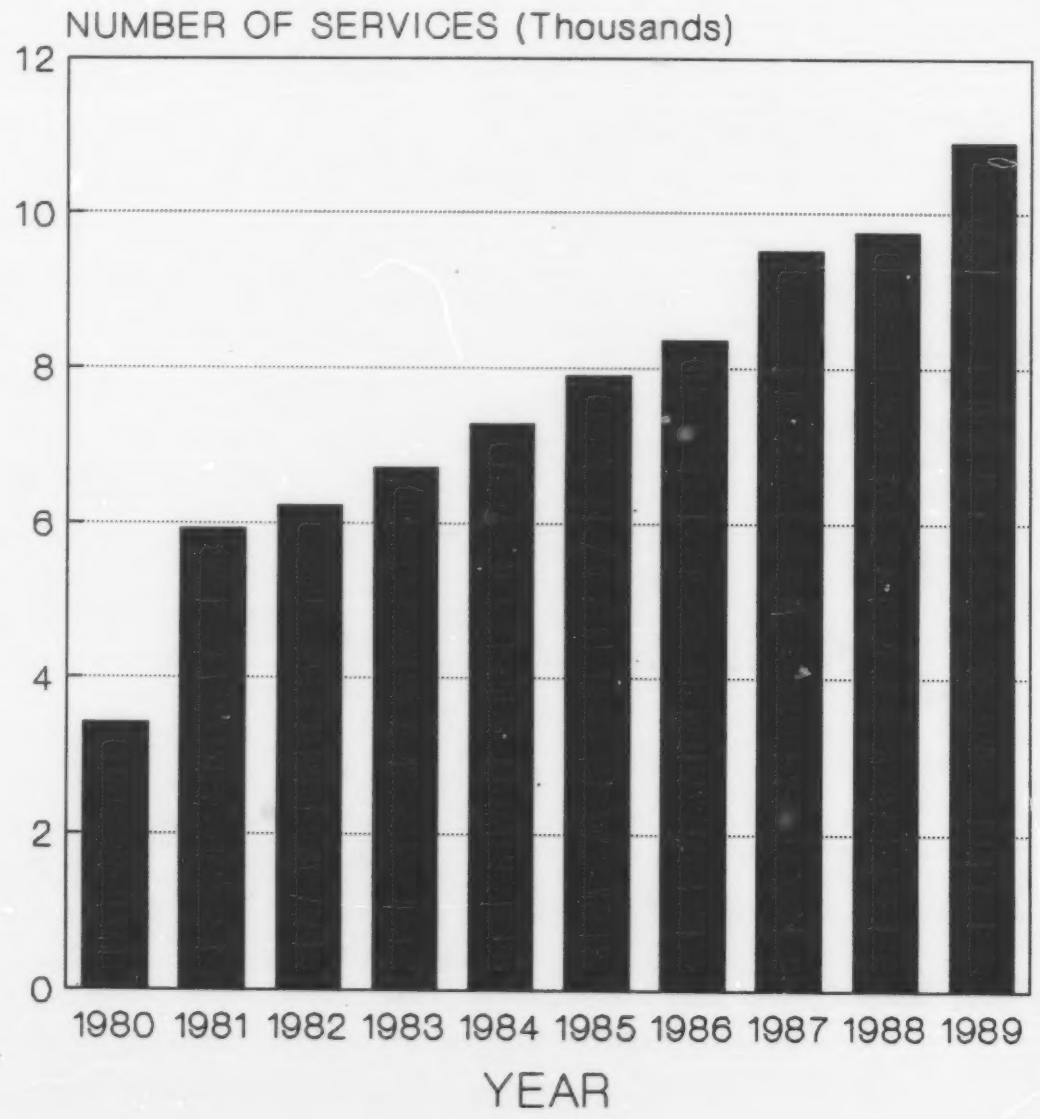
The total numbers of CTS billings to OHIP were available in aggregate from 1980 through 1989 but age and sex specific numbers of billings were available only for 1985, 1988 and 1989. The age-, sex-specific proportions for these three years were very similar (Figure 2; the p-value for year effect in analysis of variance was 0.69 for females and 0.47 for males); consequently the age-sex specific proportions were assumed to be similar over time and the proportions for 1988 were used to determine population rates.

Rates were computed for two time periods, 1979-83, and 1984-1990. Population counts for the general population by age, sex and year were obtained (Statistics Canada), using the values for the mid-period (census year) populations, 1981 and 1986. Age-,sex-, calendar time-specific "rates" were thus the product of (i) the 1988 age-sex specific CTS proportion described above, and (ii) the average of the yearly total numbers of CTS operations over the time period, divided by (iii) age-,sex-,calendar time-specific population counts.

The number of expected cases were derived by multiplying the estimated sex-, age-, calendar time-specific "provincial rates" for total CTS operations described above by the number of PYARs accumulated in the study population.

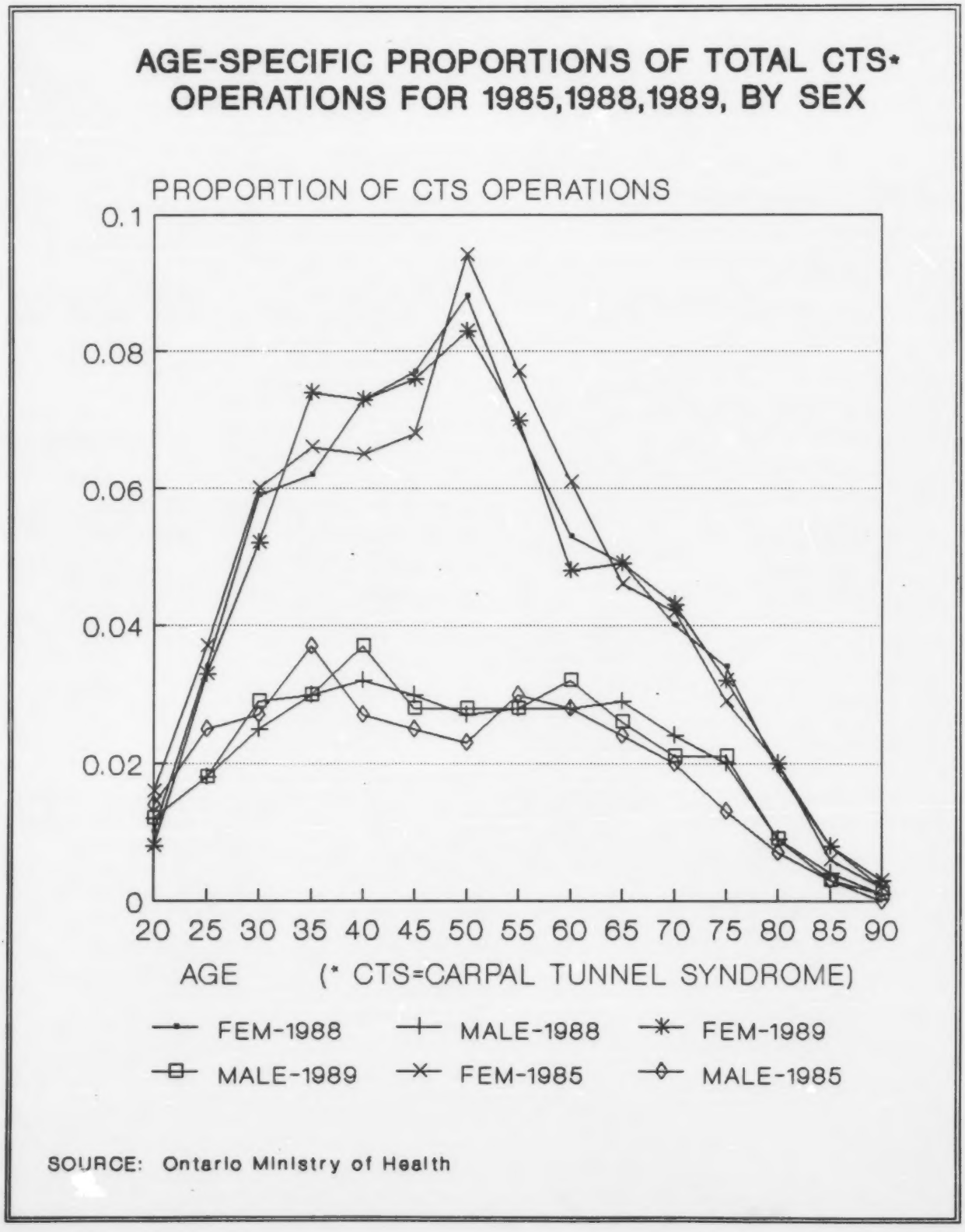
FIGURE 1

SERVICES BILLED TO OHIP FOR CARPAL TUNNEL SYNDROME OPERATIONS, 1980-1989



SOURCE: Ontario Ministry of Health

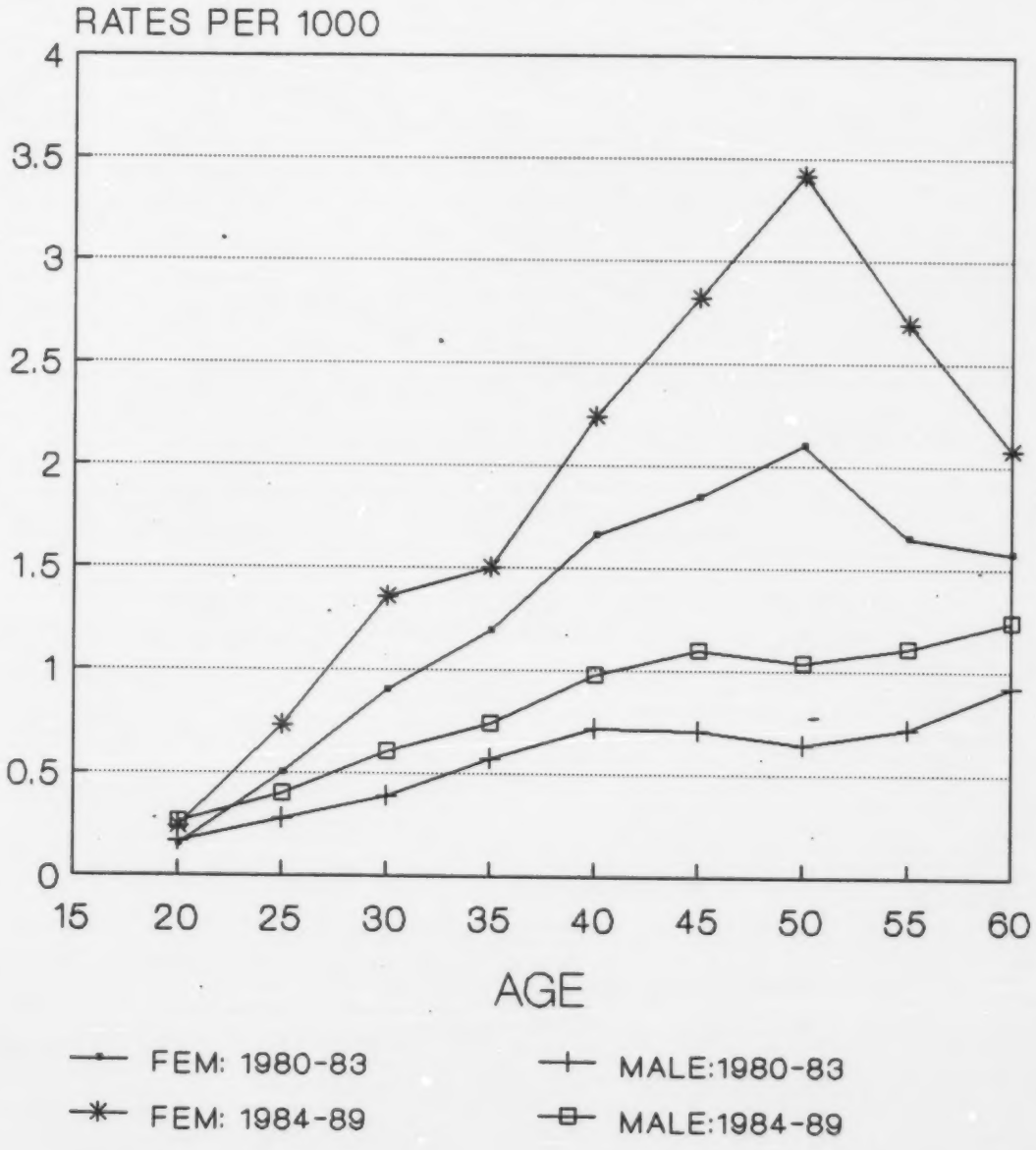
FIGURE 2



SOURCE: Ontario Ministry of Health

FIGURE 3

CARPAL TUNNEL SYNDROME OPERATION RATES, BY AGE, SEX AND TIME PERIOD



SOURCE: Based on OHIP data